

We claim:

- 1 1. A medical device comprising a substrate comprising a passivating
2 coating comprising keratin, said passivating coating being effective to increase bone
3 matrix formation exhibited by cultured 2T3 mouse osteoblasts cells.
- 1 2. The medical device of claim 1 selected from the group consisting of
2 tissue engineering constructs, orthopedic implants, dental implants, and ventricular
3 assist devices.
- 1 3. The medical device of claim 1 comprising a medical implant.
- 1 4. The medical device of claim 3 wherein said substrate comprises a
2 biocompatible material.
- 1 5. The medical device of claim 4 wherein the biocompatible material is
2 selected from the group consisting of metals, metal alloys, and ceramics.
- 1 6. The medical device of claim 5 wherein said biocompatible material is
2 selected from the group consisting of titanium and hydroxyapatite.
- 1 7. The medical device of claim 1 wherein said passivating coating
2 comprises keratin and one or more bioactive factors selected from the group
3 consisting of bone morphogenetic protein (BMP) and transforming growth factor beta
4 (TGF- β).
- 1 8. The medical device of claim 2 wherein said passivating coating
2 comprises keratin and one or more bioactive factors selected from the group
3 consisting of bone morphogenetic protein (BMP) and transforming growth factor beta
4 (TGF- β).
- 1 9. The medical device of claim 3 wherein said passivating coating
2 comprises keratin and one or more bioactive factors selected from the group

3 consisting of bone morphogenetic protein (BMP) and transforming growth factor beta
4 (TGF- β).

1 10. The medical device of claim 1 wherein said keratin is derived from a
2 material selected from the group consisting of hair, fur, feathers, horns, hooves, beaks,
3 and feet.

1 11. The medical device of claim 3 wherein said keratin is derived from a
2 material selected from the group consisting of hair, fur, feathers, horns, hooves, beaks,
3 and feet.

1 12. The medical device of claim 9 wherein said keratin is derived from a
2 material selected from the group consisting of hair, fur, feathers, horns, hooves, beaks,
3 and feet.

1 13. The medical device of claim 1 wherein said keratin is derived from
2 hair.

1 14. The medical device of claim 3 wherein said keratin is derived from
2 hair.

1 15. The medical device of claim 9 wherein said keratin is derived from
2 hair.

1 16. The medical device of claim 1 wherein said keratin is human hair
2 keratin.

1 17. The medical device of claim 3 wherein said keratin is human hair
2 keratin.

1 18. The medical device of claim 9 wherein said keratin is human hair
2 keratin.

1 19. The medical device of claim 1 wherein said keratin comprises reduced
2 keratin.

1 20. The medical device of claim 3 wherein said keratin comprises reduced
2 keratin.

1 21. The medical device of claim 9 wherein said keratin comprises reduced
2 keratin.

1 22. The medical device of claim 17 wherein said keratin comprises
2 reduced keratin.

1 23. The medical device of claim 18 wherein said keratin comprises
2 reduced keratin.

1 24. The medical device of claim 1 wherein said keratin comprises high
2 molecular weight keratin (HMWK) having a molecular weight of from about 50 to
3 about 85 kDa.

1 25. The medical device of claim 3 wherein said keratin comprises high
2 molecular weight keratin (HMWK) having a molecular weight of from about 50 to
3 about 85 kDa.

1 26. The medical device of claim 9 wherein said keratin comprises high
2 molecular weight keratin (HMWK) having a molecular weight of from about 50 to
3 about 85 kDa.

1 27. The medical device of claim 18 wherein said keratin comprises high
2 molecular weight keratin (HMWK) having a molecular weight of from about 50 to
3 about 85 kDa.

1 28. The medical device of claim 23 wherein said keratin comprises high
2 molecular weight keratin (HMWK) having a molecular weight of from about 50 to
3 about 85 kDa.

1 29. The medical device of claim 1 wherein said passivating coating is
2 effective to accelerate bone matrix formation by cultured 2T3 mouse osteoblasts.

1 30. The medical device of claim 3 wherein said passivating coating is
2 effective to accelerate bone matrix formation by cultured 2T3 mouse osteoblasts.

1 31. The medical device of claim 9 wherein said passivating coating is
2 effective to accelerate bone matrix formation by cultured 2T3 mouse osteoblasts.

1 32. The medical device of claim 23 wherein said passivating coating is
2 effective to accelerate bone matrix formation by cultured 2T3 mouse osteoblasts.

1 33. The medical device of claim 28 wherein said passivating coating is
2 effective to accelerate bone matrix formation by cultured 2T3 mouse osteoblasts.

1 34. A medical implant comprising:
2 a substrate comprising a passivating coating comprising keratin, said
3 passivating coating being effective to increase bone matrix formation
4 by cultured 2T3 mouse osteoblasts, said passivating coating
5 comprising a bonding region and a bioactive region;
6 said bonding region comprising at least one organosilane compound
7 comprising a silane component bound to a surface of said substrate;
8 and
9 said bioactive region comprising an organic component of said organosilane
10 bound to a reactive pendant group on said keratin.

1 35. The medical implant of claim 34 wherein said silane component of
2 said organosilane compound is covalently bonded with a surface of the substrate.

1 36. The medical implant of claim 34 wherein said bioactive region
2 comprises reactive pendant groups on said keratin covalently bonded to said organic
3 component of said organosilane.

1 37. The medical implant of claim 35 wherein said bioactive region
2 comprises reactive pendant groups on said keratin covalently bonded to said organic
3 component of said organosilane.

1 38. The medical implant of claim 34 wherein said passivating coating
2 comprises keratin and one or more bioactive factors selected from the group
3 consisting of bone morphogenetic protein (BMP) and transforming growth factor beta
4 (TGF- β).

1 39. The medical implant of claim 35 wherein said passivating coating
2 comprises keratin and one or more bioactive factors selected from the group
3 consisting of bone morphogenetic protein (BMP) and transforming growth factor beta
4 (TGF- β).

1 40. The medical implant of claim 36 wherein said passivating coating
2 comprises keratin and one or more bioactive factors selected from the group
3 consisting of bone morphogenetic protein (BMP) and transforming growth factor beta
4 (TGF- β).

1 41. The medical implant of claim 37 wherein said passivating coating
2 comprises keratin and one or more bioactive factors selected from the group
3 consisting of bone morphogenetic protein (BMP) and transforming growth factor beta
4 (TGF- β).

1 42. The medical implant of claim 34 wherein said organic component of
2 said organosilane comprises a moiety selected from the group consisting of epoxy
3 groups, alkoxy groups, vinyl groups, amine groups, isocyanate groups, and carboxyl
4 groups.

1 43. The medical implant of claim 34 wherein said organic component of
2 said organosilane comprises a moiety selected from the group consisting of epoxy
3 groups, alkoxy groups, vinyl groups, and amine groups.

1 44. The medical implant of claim 43 wherein said amine groups are
2 alkylamine groups.

1 45. The medical implant of claim 34 wherein said organic component
2 comprises a moiety selected from the group consisting of vinyl groups and epoxy
3 groups.

1 46. The medical implant of claim 36 wherein said organic component of
2 said organosilane comprises a moiety selected from the group consisting of epoxy
3 groups, alkoxy groups, vinyl groups, amine groups, isocyanate groups, and carboxyl
4 groups.

1 47. The medical implant of claim 36 wherein said organic component of
2 said organosilane comprises a moiety selected from the group consisting of epoxy
3 groups, alkoxy groups, vinyl groups, and amine groups.

1 48. The medical implant of claim 51 wherein said amine groups are
2 alkylamine groups.

1 49. The medical implant of claim 36 wherein said organic component
2 comprises a moiety selected from the group consisting of vinyl groups and epoxy
3 groups.

1 50. The medical implant of claim 37 wherein said organic component of
2 said organosilane comprises a moiety selected from the group consisting of epoxy
3 groups, alkoxy groups, vinyl groups, amine groups, isocyanate groups, and carboxyl
4 groups.

1 51. The medical implant of claim 37 wherein said organic component of
2 said organosilane comprises a moiety selected from the group consisting of epoxy
3 groups, alkoxy groups, vinyl groups, and amine groups.

1 52. The medical implant of claim 55 wherein said amine groups are
2 alkylamine groups.

1 53. The medical implant of claim 37 wherein said organic component
2 comprises a moiety selected from the group consisting of vinyl groups and epoxy
3 groups.

1 54. The medical implant of claim 41 wherein said organic component of
2 said organosilane comprises a moiety selected from the group consisting of epoxy
3 groups, alkoxy groups, vinyl groups, amine groups, isocyanate groups, and carboxyl
4 groups.

1 55. The medical implant of claim 41 wherein said organic component of
2 said organosilane comprises a moiety selected from the group consisting of epoxy
3 groups, alkoxy groups, vinyl groups, and amine groups.

1 56. The medical implant of claim 59 wherein said amine groups are
2 alkylamine groups.

1 57. The medical implant of claim 41 wherein said organic component
2 comprises a moiety selected from the group consisting of vinyl groups and epoxy
3 groups.

1 58. The medical implant of claim 34 wherein said organosilane comprises
2 substituents selected from the group consisting of from about 1 to 3 halogens and
3 from about 1 to 3 alkoxy groups.

1 59. The medical implant of claim 36 wherein said organosilane comprises
2 substituents selected from the group consisting of from about 1 to 3 halogens and
3 from about 1 to 3 alkoxy groups.

1 60. The medical implant of claim 37 wherein said organosilane comprises
2 substituents selected from the group consisting of from about 1 to 3 halogens and
3 from about 1 to 3 alkoxy groups.

1 61. The medical implant of claim 41 wherein said organosilane comprises
2 substituents selected from the group consisting of from about 1 to 3 halogens and
3 from about 1 to 3 alkoxy groups.

1 62. The medical implant of claim 54 wherein said organosilane comprises
2 substituents selected from the group consisting of from about 1 to 3 halogens and
3 from about 1 to 3 alkoxy groups.

1 63. The medical implant of claim 57 wherein said organosilane comprises
2 substituents selected from the group consisting of from about 1 to 3 halogens and
3 from about 1 to 3 alkoxy groups.

1 64. The medical implant of claim 34 wherein said passivating coating is
2 effective to accelerate bone matrix formation in cultured 2T3 mouse osteoblasts.

1 65. The medical implant of claim 36 wherein said passivating coating is
2 effective to accelerate bone matrix formation in cultured 2T3 mouse osteoblasts.

1 66. The medical implant of claim 37 wherein said passivating coating is
2 effective to accelerate bone matrix formation in cultured 2T3 mouse osteoblasts.

1 67. The medical implant of claim 41 wherein said passivating coating is
2 effective to accelerate bone matrix formation in cultured 2T3 mouse osteoblasts.

1 68. The medical implant of claim 54 wherein said passivating coating is
2 effective to accelerate bone matrix formation in cultured 2T3 mouse osteoblasts.

1 69. The medical implant of claim 57 wherein said passivating coating is
2 effective to accelerate bone matrix formation in cultured 2T3 mouse osteoblasts.

1 70. The medical implant of claim 63 wherein said passivating coating is
2 effective to accelerate bone matrix formation in cultured 2T3 mouse osteoblasts.

1 71. The medical implant of claim 34 wherein said keratin comprises high
2 molecular weight keratin (HMWK) having a molecular weight of from about 50 to
3 about 85 kDa.

1 72. The medical implant of claim 36 wherein said keratin comprises high
2 molecular weight keratin (HMWK) having a molecular weight of from about 50 to
3 about 85 kDa.

1 73. The medical implant of claim 37 wherein said keratin comprises high
2 molecular weight keratin (HMWK) having a molecular weight of from about 50 to
3 about 85 kDa.

1 74. The medical implant of claim 51 wherein said keratin comprises high
2 molecular weight keratin (HMWK) having a molecular weight of from about 50 to
3 about 85 kDa.

1 75. The medical implant of claim 54 wherein said keratin comprises high
2 molecular weight keratin (HMWK) having a molecular weight of from about 50 to
3 about 85 kDa.

1 76. The medical implant of claim 57 wherein said keratin comprises high
2 molecular weight keratin (HMWK) having a molecular weight of from about 50 to
3 about 85 kDa.

1 77. The medical implant of claim 63 wherein said keratin comprises high
2 molecular weight keratin (HMWK) having a molecular weight of from about 50 to
3 about 85 kDa.

1 78. The medical implant of claim 70 wherein said keratin comprises high
2 molecular weight keratin (HMWK) having a molecular weight of from about 50 to
3 about 85 kDa.

1 79. A medical implant comprising:
2 a substrate comprising a biocompatible material selected from the group
3 consisting of metals, metal alloys, and ceramics;
4 a passivating coating on said substrate comprising HMWK keratin and one or
5 more bioactive factors selected from the group consisting of bone
6 morphogenetic protein (BMP) and transforming growth factor beta
7 (TGF- β), said passivating coating being effective to increase bone
8 matrix formation by cultured 2T3 mouse osteoblasts said passivating
9 coating comprising an organosilane compound comprising a silane
10 component and an organic component, said passivating coating
11 comprising a bonding region and a bioactive region;
12 said bonding region comprising said silane component covalently bound to a
13 surface of said substrate; and
14 said bioactive region comprising said organic component covalently bound to
15 a reactive pendant group on said keratin.

1 80. The medical implant of claim 79 wherein said organic component of
2 said organosilane comprises a moiety selected from the group consisting of epoxy
3 groups, alkoxy groups, vinyl groups, amine groups, isocyanate groups, and carboxyl
4 groups.

1 81. The medical implant of claim 79 wherein said organic component of
2 said organosilane comprises a moiety selected from the group consisting of epoxy
3 groups, alkoxy groups, vinyl groups, and amine groups.

1 82. The medical implant of claim 81 wherein said amine groups are
2 alkylamine groups.

1 83. The medical implant of claim 79 wherein said organic component
2 comprises a moiety selected from the group consisting of vinyl groups and epoxy
3 groups.

1 84. The medical implant of claim 79 wherein said organosilane comprises
2 substituents selected from the group consisting of from about 1 to 3 halogens and
3 from about 1 to 3 alkoxy groups.

1 85. The medical implant of claim 80 wherein said organosilane comprises
2 substituents selected from the group consisting of from about 1 to 3 halogens and
3 from about 1 to 3 alkoxy groups.

1 86. The medical implant of claim 81 wherein said organosilane comprises
2 substituents selected from the group consisting of from about 1 to 3 halogens and
3 from about 1 to 3 alkoxy groups.

1 87. The medical implant of claim 82 wherein said organosilane comprises
2 substituents selected from the group consisting of from about 1 to 3 halogens and
3 from about 1 to 3 alkoxy groups.

1 88. The medical implant of claim 83 wherein said organosilane comprises
2 substituents selected from the group consisting of from about 1 to 3 halogens and
3 from about 1 to 3 alkoxy groups.

1 89. The medical implant of claim 79 wherein the medical implant is
2 selected from the group consisting of a issue engineering construct, an orthopedic
3 implant, a dental implant, and a ventricular assist device.

1 90. The medical implant of claim 79 wherein said biocompatible material
2 is selected from the group consisting of titanium and hydroxyapatite.

1 91. A medical implant comprising:
2 a substrate comprising titanium;
3 a passivating coating on said substrate comprising HMWK keratin and one or
4 more bioactive factors selected from the group consisting of bone
5 morphogenetic protein (BMP) and transforming growth factor beta
6 (TGF- β), said passivating coating being effective to increase bone
7 matrix formation by cultured 2T3 mouse osteoblasts said passivating
8 coating comprising an organosilane compound comprising a silane
9 component and an organic component, said passivating coating
10 comprising a bonding region and a bioactive region;
11 said bonding region comprising said silane component covalently bound to a
12 surface of said substrate; and
13 said bioactive region comprising said organic component covalently bound to
14 a reactive pendant group on said keratin.

1 92. The medical implant of claim 91 wherein said organic component of
2 said organosilane comprises a moiety selected from the group consisting of epoxy

3 groups, alkoxy groups, vinyl groups, amine groups, isocyanate groups, and carboxyl
4 groups.

1 93. The medical implant of claim 91 wherein said organic component of
2 said organosilane comprises a moiety selected from the group consisting of epoxy
3 groups, alkoxy groups, vinyl groups, and amine groups.

1 94. The medical implant of claim 93 wherein said amine groups are
2 alkylamine groups.

1 95. The medical implant of claim 91 wherein said organic component
2 comprises a moiety selected from the group consisting of vinyl groups and epoxy
3 groups.

1 96. The medical implant of claim 91 wherein said organosilane comprises
2 substituents selected from the group consisting of from about 1 to 3 halogens and
3 from about 1 to 3 alkoxy groups.

1 97. The medical implant of claim 92 wherein said organosilane comprises
2 substituents selected from the group consisting of from about 1 to 3 halogens and
3 from about 1 to 3 alkoxy groups.

1 98. The medical implant of claim 93 wherein said organosilane comprises
2 substituents selected from the group consisting of from about 1 to 3 halogens and
3 from about 1 to 3 alkoxy groups.

1 99. The medical implant of claim 94 wherein said organosilane comprises
2 substituents selected from the group consisting of from about 1 to 3 halogens and
3 from about 1 to 3 alkoxy groups.

1 100. The medical implant of claim 95 wherein said organosilane comprises
2 substituents selected from the group consisting of from about 1 to 3 halogens and
3 from about 1 to 3 alkoxy groups.

1 101. The medical implant of claim 100 wherein said halogen is chlorine.

1 102. The medical implant of claim 101 wherein the medical implant is
2 selected from the group consisting of a issue engineering construct, an orthopedic
3 implant, a dental implant, and a ventricular assist devices.

1 103. A method of coating a medical device with a passivating coating, said
2 method comprising:

3 bonding a coupling agent to one or more surfaces of said medical device,
4 producing a bonding region; and,
5 bonding keratin to said bonding region.

1 104. The method of claim 103 further comprising cleaning said one or more
2 surfaces before bonding said coupling agent to said one or more surfaces.

1 105. The method of claim 103 further comprising oxidizing said one or
2 more surfaces before bonding said coupling agent to said one or more surfaces.

1 106. The method of claim 104 further comprising oxidizing said one or
2 more surfaces before bonding said coupling agent to said one or more surfaces.

1 107. The method of claim 104 wherein said cleaning comprises sonicating
2 said one or more surfaces in first anhydrous solvent and sonicating said one or more
3 surfaces in water.

1 108. The method of claim 107 wherein said first anhydrous solvent is
2 selected from the group consisting of methanol, ethanol, isopropyl alcohol,
3 dimethylsulfoxide, acetone, or tetrahydrofuran.

1 109. The method of claim 107 wherein said first anhydrous solvent is
2 dichloromethane.

1 110. The method of claim 106 wherein said cleaning comprises sonicating
2 in said one or more surfaces in first anhydrous solvent and sonicating said one or
3 more surfaces in water.

1 111. The method of claim 110 wherein said first anhydrous solvent is
2 selected from the group consisting of methanol, ethanol, isopropyl alcohol,
3 dimethylsulfoxide, acetone, or tetrahydrofuran.

1 112. The method of claim 110 wherein said first anhydrous solvent is
2 dichloromethane.

1 113. The method of claim 110 wherein said water is deionized water.

1 114. The method of claim 112 wherein said water is deionized water.

1 115. The method of claim 103 wherein bonding keratin to said bonding
2 region comprises:

3 dissolving keratin in a solvent; and

4 adding second anhydrous solvent to produce a keratin mixture;

5 exposing said bonding region to said keratin mixture, producing a keratin

6 coated bonding region; and

7 curing said keratin coated bonding region under conditions effective to

8 produce said bioactive region.

1 116. The method of claim 106 wherein bonding keratin to said bonding
2 region comprises:

3 dissolving keratin in a solvent; and

4 adding second anhydrous solvent to produce a keratin mixture;

5 exposing said bonding region to said keratin mixture, producing a keratin
6 coated bonding region; and
7 curing said keratin coated bonding region under conditions effective to
8 produce said bioactive region.

1 117. The method of claim 110 wherein bonding keratin to said bonding
2 region comprises:

3 dissolving keratin in a solvent; and
4 adding second anhydrous solvent to produce a keratin mixture;
5 exposing said bonding region to said keratin mixture, producing a keratin
6 coated bonding region; and
7 curing said keratin coated bonding region under conditions effective to
8 produce said bioactive region.

1 118. The method of claim 111 wherein bonding keratin to said bonding
2 region comprises:

3 dissolving keratin in a solvent; and
4 adding second anhydrous solvent to produce a keratin mixture;
5 exposing said bonding region to said keratin mixture, producing a keratin
6 coated bonding region; and
7 curing said keratin coated bonding region under conditions effective to
8 produce said bioactive region.

1 119. The method of claim 112 wherein bonding keratin to said bonding
2 region comprises:

3 dissolving keratin in a solvent; and
4 adding second anhydrous solvent to produce a keratin mixture;

5 exposing said bonding region to said keratin mixture, producing a keratin
6 coated bonding region; and
7 curing said keratin coated bonding region under conditions effective to
8 produce said bioactive region.

1 120. The method of claim 103 wherein, when said keratin is
2 reduced/reduced keratin, said solvent is water.

1 121. The method of claim 103 wherein, when said keratin is
2 oxidized/reduced keratin, said solvent comprises an aqueous solution comprising a
3 base.

1 122. The method of claim 121 wherein said base is selected from the group
2 consisting of ammonium hydroxide, sodium hydroxide, potassium hydroxide, and
3 combinations thereof.

1 123. The method of claim 122 wherein said base is ammonium hydroxide.

1 124. The method of claim 115 wherein said second anhydrous solvent is
2 selected from the group consisting of methanol, ethanol, isopropyl alcohol,
3 dimethylsulfoxide, acetone, and tetrahydrofuran.

1 125. The method of claim 115 wherein said second anhydrous solvent is
2 dimethylsulfoxide.

1 126. The method of claim 116 wherein said second anhydrous solvent is
2 selected from the group consisting of methanol, ethanol, isopropyl alcohol,
3 dimethylsulfoxide, acetone, and tetrahydrofuran.

1 127. The method of claim 116 wherein said second anhydrous solvent is
2 dimethylsulfoxide.

1 128. The method of claim 117 wherein said second anhydrous solvent is
2 selected from the group consisting of methanol, ethanol, isopropyl alcohol,
3 dimethylsulfoxide, acetone, and tetrahydrofuran.

1 129. The method of claim 117 wherein said second anhydrous solvent is
2 dimethylsulfoxide.

1 130. The method of claim 118 wherein said second anhydrous solvent is
2 selected from the group consisting of methanol, ethanol, isopropyl alcohol,
3 dimethylsulfoxide, acetone, and tetrahydrofuran.

1 131. The method of claim 118 wherein said second anhydrous solvent is
2 dimethylsulfoxide.

1 132. The method of claim 119 wherein said second anhydrous solvent is
2 selected from the group consisting of methanol, ethanol, isopropyl alcohol,
3 dimethylsulfoxide, acetone, and tetrahydrofuran.

1 133. The method of claim 119 wherein said second anhydrous solvent is
2 dimethylsulfoxide.

1 134. The method of claim 120 wherein said second anhydrous solvent is
2 selected from the group consisting of methanol, ethanol, isopropyl alcohol,
3 dimethylsulfoxide, acetone, and tetrahydrofuran.

1 135. The method of claim 120 wherein said second anhydrous solvent is
2 dimethylsulfoxide.

1 136. The method of claim 121 wherein said second anhydrous solvent is
2 selected from the group consisting of methanol, ethanol, isopropyl alcohol,
3 dimethylsulfoxide, acetone, and tetrahydrofuran.

1 137. The method of claim 121 wherein said second anhydrous solvent is
2 dimethylsulfoxide.

1 138. The method of claim 115 further comprising mixing the keratin
2 mixture with an activation agent selected from the group consisting of a catalyst and
3 an initiator.

1 139. The method of claim 138 wherein said activation agent is a vinyl-
2 functional silane and said activation agent is effective to generate free radicals.

1 140. The method of claim 138 wherein said activation agent comprises an
2 anthraquinone-2-sulfonic acid.

1 141. The method of claim 116 further comprising mixing the keratin
2 mixture with an activation agent selected from the group consisting of a catalyst and
3 an initiator.

1 142. The method of claim 141 wherein said activation agent is a vinyl-
2 functional silane and said activation agent is effective to generate free radicals.

1 143. The method of claim 141 wherein said activation agent comprises an
2 anthraquinone-2-sulfonic acid.

1 144. The method of claim 119 further comprising mixing the keratin
2 mixture with an activation agent selected from the group consisting of a catalyst and
3 an initiator.

1 145. The method of claim 119 wherein said activation agent is a vinyl-
2 functional silane and said reagent is effective to generate free radicals.

1 146. The method of claim 145 wherein said activation agent comprises an
2 anthraquinone-2-sulfonic acid.

1 147. The method of claim 115 wherein said conditions comprises exposing
2 said keratin coated bonding region to an energy source for a period of time effective
3 to produce said bioactive region.

1 148. The method of claim 119 wherein said conditions comprises exposing
2 said keratin coated bonding region to an energy source for a period of time effective
3 to produce said bioactive region.

1 149. The method of claim 146 wherein said conditions comprises exposing
2 said keratin coated bonding region to an energy source for a period of time effective
3 to produce said bioactive region.

1 150. The method of claim 147 wherein said conditions comprises exposing
2 said keratin coated bonding region to an energy source for a period of time effective
3 to produce said bioactive region.

1 151. The method of claim 146 wherein said conditions comprise the
2 presence of said activation agent.

1 152. The method of claim 150 wherein said conditions comprise the
2 presence of said activation agent.

1 153. The method of claim 149 wherein said period of time is from about 1
2 to about 24 hours

1 154. The method of claim 150 wherein said period of time is from about 1
2 to about 24 hours

1 155. The method of claim 151 wherein said period of time is from about 1
2 to about 24 hours

1 156. The method of claim 152 wherein said period of time is from about 1
2 to about 24 hours

1 157. The method of claim 149 wherein said period of time is about 24
2 hours.

1 158. The method of claim 150 wherein said period of time is about 24
2 hours.

1 159. The method of claim 151 wherein said period of time is about 24
2 hours.

1 160. The method of claim 152 wherein said period of time is about 24
2 hours.

1 161. A medical implant comprising:
2 a substrate comprising a passivating coating comprising keratin, said
3 passivating coating comprising a bonding region and a bioactive
4 region;
5 said bonding region comprising at least one organosilane compound
6 comprising a silane component bound to a surface of said substrate;
7 and
8 said bioactive region comprising an organic component of said organosilane
9 bound to a reactive pendant group on said keratin.

1 162. The medical implant of claim 161 wherein said silane component of
2 said organosilane compound is covalently bonded with a surface of the substrate.

1 163. The medical implant of claim 161 wherein said bioactive region
2 comprises reactive pendant groups on said keratin covalently bonded to said organic
3 component of said organosilane.

1 164. The medical implant of claim 162 wherein said bioactive region
2 comprises reactive pendant groups on said keratin covalently bonded to said organic
3 component of said organosilane.

1 165. The medical implant of claim 161 wherein said organic component of
2 said organosilane comprises a moiety selected from the group consisting of epoxy
3 groups, alkoxy groups, vinyl groups, amine groups, isocyanate groups, and carboxyl
4 groups.

1 166. The medical implant of claim 161 wherein said organic component of
2 said organosilane comprises a moiety selected from the group consisting of epoxy
3 groups, alkoxy groups, vinyl groups, and amine groups.

1 167. The medical implant of claim 166 wherein said amine groups are
2 alkylamine groups.

1 168. The medical implant of claim 162 wherein said organic component
2 comprises a moiety selected from the group consisting of vinyl groups and epoxy
3 groups.

1 169. The medical implant of claim 163 wherein said organic component of
2 said organosilane comprises a moiety selected from the group consisting of epoxy
3 groups, alkoxy groups, vinyl groups, amine groups, isocyanate groups, and carboxyl
4 groups.

1 170. The medical implant of claim 163 wherein said organic component of
2 said organosilane comprises a moiety selected from the group consisting of epoxy
3 groups, alkoxy groups, vinyl groups, and amine groups.

1 171. The medical implant of claim 170 wherein said amine groups are
2 alkylamine groups.

1 172. The medical implant of claim 163 wherein said organic component
2 comprises a moiety selected from the group consisting of vinyl groups and epoxy
3 groups.

1 173. The medical implant of claim 164 wherein said organic component of
2 said organosilane comprises a moiety selected from the group consisting of epoxy
3 groups, alkoxy groups, vinyl groups, amine groups, isocyanate groups, and carboxyl
4 groups.

1 174. The medical implant of claim 164 wherein said organic component of
2 said organosilane comprises a moiety selected from the group consisting of epoxy
3 groups, alkoxy groups, vinyl groups, and amine groups.

1 175. The medical implant of claim 174 wherein said amine groups are
2 alkylamine groups.

1 176. The medical implant of claim 174 wherein said organic component
2 comprises a moiety selected from the group consisting of vinyl groups and epoxy
3 groups.

1 177. The medical implant of claim 161 wherein said organosilane comprises
2 substituents selected from the group consisting of from about 1 to 3 halogens and
3 from about 1 to 3 alkoxy groups.

1 178. The medical implant of claim 162 wherein said organosilane comprises
2 substituents selected from the group consisting of from about 1 to 3 halogens and
3 from about 1 to 3 alkoxy groups.

1 179. The medical implant of claim 163 wherein said organosilane
2 comprises substituents selected from the group consisting of from about 1 to 3
3 halogens and from about 1 to 3 alkoxy groups.

1 180. The medical implant of claim 169 wherein said organosilane
2 comprises substituents selected from the group consisting of from about 1 to 3
3 halogens and from about 1 to 3 alkoxy groups.

1 181. The medical implant of claim 170 wherein said organosilane comprises
2 substituents selected from the group consisting of from about 1 to 3 halogens and
3 from about 1 to 3 alkoxy groups.

1 182. The medical implant of claim 171 wherein said organosilane comprises
2 substituents selected from the group consisting of from about 1 to 3 halogens and
3 from about 1 to 3 alkoxy groups.

1 183. The medical implant of claim 172 wherein said organosilane comprises
2 substituents selected from the group consisting of from about 1 to 3 halogens and
3 from about 1 to 3 alkoxy groups.

1 184. The medical implant of claim 175 wherein said organosilane comprises
2 substituents selected from the group consisting of from about 1 to 3 halogens and
3 from about 1 to 3 alkoxy groups.

1 185. The medical implant of claim 176 wherein said organosilane comprises
2 substituents selected from the group consisting of from about 1 to 3 halogens and
3 from about 1 to 3 alkoxy groups.

1 186. The medical implant of claim 161 wherein said keratin comprises high
2 molecular weight keratin (HMWK) having a molecular weight of from about 50 to
3 about 85 kDa.

1 187. The medical implant of claim 162 wherein said keratin comprises high
2 molecular weight keratin (HMWK) having a molecular weight of from about 50 to
3 about 85 kDa.

1 188. The medical implant of claim 163 wherein said keratin comprises high
2 molecular weight keratin (HMWK) having a molecular weight of from about 50 to
3 about 85 kDa.

1 189. The medical implant of claim 169 wherein said keratin comprises high
2 molecular weight keratin (HMWK) having a molecular weight of from about 50 to
3 about 85 kDa.

1 190. The medical implant of claim 170 wherein said keratin comprises high
2 molecular weight keratin (HMWK) having a molecular weight of from about 50 to
3 about 85 kDa.

1 191. The medical implant of claim 171 wherein said keratin comprises high
2 molecular weight keratin (HMWK) having a molecular weight of from about 50 to
3 about 85 kDa.

1 192. The medical implant of claim 172 wherein said keratin comprises high
2 molecular weight keratin (HMWK) having a molecular weight of from about 50 to
3 about 85 kDa.

1 193. The medical implant of claim 175 wherein said keratin comprises high
2 molecular weight keratin (HMWK) having a molecular weight of from about 50 to
3 about 85 kDa.

1 194. The medical implant of claim 177 wherein said keratin comprises high
2 molecular weight keratin (HMWK) having a molecular weight of from about 50 to
3 about 85 kDa.

1 195. The medical implant of claim 178 wherein said keratin comprises high
2 molecular weight keratin (HMWK) having a molecular weight of from about 50 to
3 about 85 kDa.

1 196. The medical implant of claim 182 wherein said keratin comprises high
2 molecular weight keratin (HMWK) having a molecular weight of from about 50 to
3 about 85 kDa.

1 197. The medical implant of claim 183 wherein said keratin comprises high
2 molecular weight keratin (HMWK) having a molecular weight of from about 50 to
3 about 85 kDa.

1 198. The medical implant of claim 184 wherein said keratin comprises high
2 molecular weight keratin (HMWK) having a molecular weight of from about 50 to
3 about 85 kDa.

1 199. The medical implant of claim 185 wherein said keratin comprises high
2 molecular weight keratin (HMWK) having a molecular weight of from about 50 to
3 about 85 kDa.

1 200. The medical implant of claim 161 wherein the substrate comprises one
2 or more biocompatible material is selected from the group consisting of silicon,
3 metals, metal alloys, and ceramics.

1 201. The medical implant of claim 161 wherein said biocompatible material
2 is selected from the group consisting of titanium and hydroxyapatite.

1 202. The medical implant of claim 161 wherein said biocompatible material
2 comprises silicon.

1 203. The medical implant of claim 164 wherein the substrate comprises one
2 or more biocompatible material is selected from the group consisting of silicon,
3 metals, metal alloys, and ceramics.

1 204. The medical implant of claim 164 wherein said biocompatible material
2 is selected from the group consisting of titanium and hydroxyapatite.

1 205. The medical implant of claim 164 wherein said biocompatible material
2 comprises silicon.

1 206. The medical implant of claim 176 wherein the substrate comprises one
2 or more biocompatible material is selected from the group consisting of silicon,
3 metals, metal alloys, and ceramics.

1 207. The medical implant of claim 176 wherein said biocompatible material
2 is selected from the group consisting of titanium and hydroxyapatite.

1 208. The medical implant of claim 176 wherein said biocompatible material
2 comprises silicon.

1 209. The medical implant of claim 184 wherein the substrate comprises one
2 or more biocompatible material is selected from the group consisting of silicon,
3 metals, metal alloys, and ceramics.

1 210. The medical implant of claim 184 wherein said biocompatible material
2 is selected from the group consisting of titanium and hydroxyapatite.

1 211. The medical implant of claim 184 wherein said biocompatible material
2 comprises silicon.

1 212. The medical implant of claim 185 wherein the substrate comprises one
2 or more biocompatible material is selected from the group consisting of silicon,
3 metals, metal alloys, and ceramics.

1 213. The medical implant of claim 185 wherein said biocompatible material
2 is selected from the group consisting of titanium and hydroxyapatite.

1 214. The medical implant of claim 185 wherein said biocompatible material
2 comprises silicon.

1 215. The medical implant of claim 198 wherein the substrate comprises one
2 or more biocompatible material is selected from the group consisting of silicon,
3 metals, metal alloys, and ceramics.

1 216. The medical implant of claim 198 wherein said biocompatible material
2 is selected from the group consisting of titanium and hydroxyapatite.

1 217. The medical implant of claim 198 wherein said biocompatible material
2 comprises silicon.

1 218. The medical implant of claim 199 wherein the substrate comprises one
2 or more biocompatible material is selected from the group consisting of silicon,
3 metals, metal alloys, and ceramics.

1 219. The medical implant of claim 199 wherein said biocompatible material
2 is selected from the group consisting of titanium and hydroxyapatite.

1 220. The medical implant of claim 199 wherein said biocompatible material
2 comprises silicon.